Table of Contents

F01 Energy Management

Subject **Page**

Subject **Page**

Subject **Page**

Energy Management

Model: F01/F02

Production: From Start of Production

OBJECTIVES

After completion of this module you will be able to:

- Understand changes to the Energy Management

Introduction

The Energy Circuit in the Vehicle

The vehicle's electrical energy system comprises all components for generating, storing, distributing and converting electrical energy.

The job of the vehicle's electrical energy system is to supply and distribute electrical energy in all vehicle operating situations. The aim is to provide all electrical components with the necessary electrical energy in all vehicle situations.

The highest-priority aims are maintaining the vehicle's ability to start and trouble-free operation of the vehicle when it is being driven. Another aim is to minimize wear (high battery energy throughput) and prevent damage to components (total battery discharge) of the vehicle's electrical system by networking, dimensioning and appropriate control of devices that consume, store and convert electrical energy.

Like the other current BMW Group models, the F01/F02 uses an energy management system to ensure balanced use of energy on the vehicle.

The energy management functions are integrated in the power management system that is implemented in the form of software on the engine management module.

Energy management encompasses a large number of functions such as:

- Power terminal shut-down
- Electric load shut-down
- Determining required battery charge voltage
- Enabling battery discharge
- Idle speed boost
- Detecting battery condition
- Vehicle programming.

The sections that follow describe only the most important changes to the energy management system.

Bus Overview and Terminal Status

The F01/F02 introduces new designations for some of the terminals. A distinction is also made between logical terminals and power supply terminals. The logical terminals are:

- Terminal R
- Terminal 15
- Terminal 50.

The power supply terminals are:

- Terminal 30
- Terminal 15N
- Terminal 30B
- Terminal 30F.

The logical terminals do not serve as power supply terminals; instead, they represent a status. They are activated/deactivated by pressing the START-STOP button.

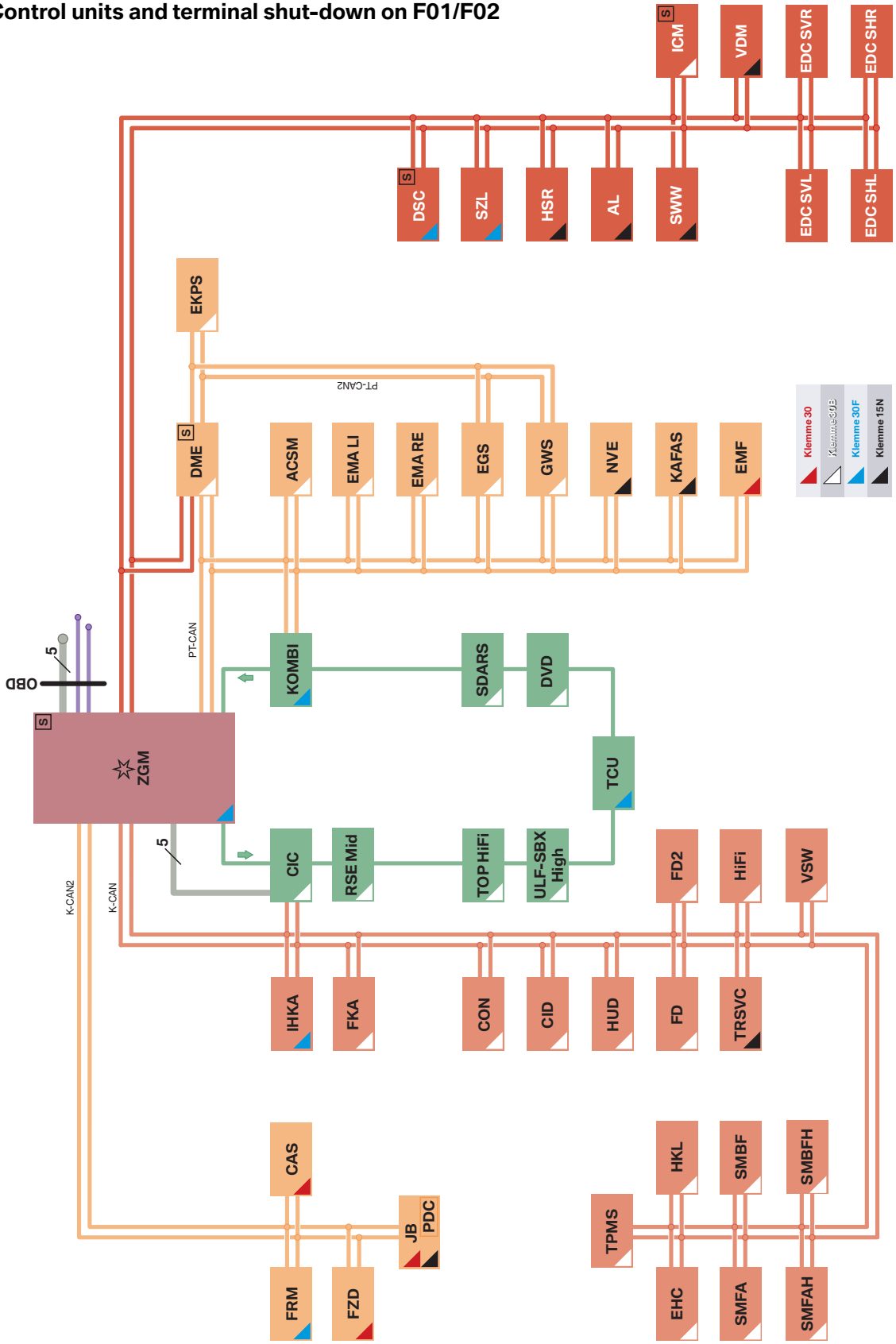
The table below details the previous and new terminal designations.

Previous	New
Terminal 15	Terminal 15N
Terminal 30g	Terminal 30B
Terminal 30g_f	Terminal 30F

For clearer illustration of terminal shut-down, the control units are identified by a colored triangle. Identification and allocation to the individual terminals are shown in the diagram below.

Color coding

Control units and terminal shut-down on F01/F02



Index	Explanation	Index	Explanation
AL	Active steering	HKL	Tailgate lift
CAS	Car Access System	HSR	Rear suspension slip angle control
CIC	Car Information Computer	HUD	Head-up display
CID	Central information display	ICM	Integrated Chassis Management
CON	Controller	IHKA	Automatic climate control
DME	Digital Motor Electronics	JBE	Junction Box electronics
DSC	Dynamic Stability Control	KAFAS	Camera-based driver assistance systems
DVD	DVD changer	Kombi	Instrument cluster
EDC SHL	Electronic Damper Control, rear left satellite unit	NVE	Night Vision module
EDC SHR	Electronic Damper Control, rear right satellite unit	PDC	Park Distance Control
EDC SVL	Electronic Damper Control, front left satellite unit	OBD	Diagnosis connector
EDC SVR	Electronic Damper Control, front right satellite unit	RSE-Mid	Rear seat entertainment
EGS	Electronic transmission control unit	SDARS	Satellite tuner
EHC	Electronic ride-height control	SMBF	Front passenger seat module
EKPS	Electric fuel pump control unit	SMBFH	Rear passenger-side seat module
EMA LI	Motorized reel, left	SMFA	Driver's seat module
EMA RE	Motorized reel, right	SMFAH	Rear driver's-side seat module
EMF	Electromechanical parking brake	SWW	Lane departure warning
FCON	Rear Controller	SZL	Steering column switch cluster
FD	Rear display	TCU	Telematics Control Unit
FD2	Rear display 2	TOP-HIFI	Top-HiFi system
FKA	Rear climate control	TPMS	Tire pressure monitoring system
FLA	Main beam assistant	TRSVC	Control unit for reversing camera and SideView
FRM	Footwell module	ULF-SBX	Interface box (ULF functionality)
FZD	Roof function center	VDM	Vertical dynamics management (central control unit for electronic damper control)
GWS	Gear selector switch	VSW	Video switch
HiFi	HiFi amplifier	ZGM	Central Gateway Module

Power Management

The power management system is a subsystem of the energy management system. The power management functions are carried out by the engine management module (DME).

The power management system regulates the power consumption of some of the most important electrical devices and the power output of the alternator while the vehicle is being driven.

Only advanced power management (APM) is used on the F01/F02.

In addition to the main functions of basic power management (idling speed and required battery charge voltage), APM also incorporates the following extended functions:

- Electric load reduction
- Electric load shut-down
- Vehicle systems diagnosis
- Battery diagnosis.

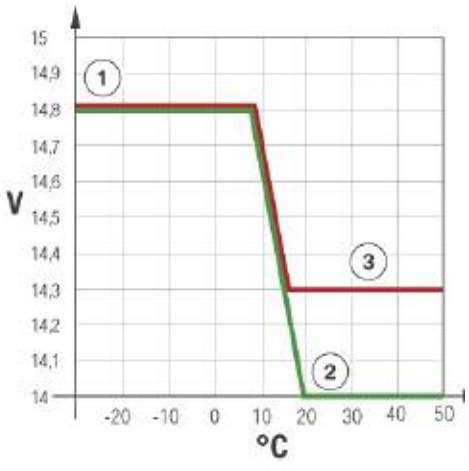
Idle Speed Boost

On vehicles with gasoline engines, the idling speed is raised by up to 200 rpm as soon as current starts to be drawn from the battery despite the alternator working at full capacity.

Charging Voltage Target Value

The required battery charge voltage is determined according to outside temperature and IGR function.

Voltage regulation on alternator on F01/F02



Index	Explanation
1	Model-based battery temperature of 8 °C
2	Model-based battery temperature of 19 °C
3	Emergency operation

Effect of Outside Temperature

The required battery charge voltage function ensures electrochemically optimum battery charging by adjusting the battery charge voltage according to temperature. Since the current absorbed by a cold battery is lower, the voltage for charging must be higher than for a warm battery.

Conversely, if that higher voltage were constantly used to charge a warm battery, there would be a risk of gas formation. Therefore, the charge voltage is regulated on the alternator according to temperature. The current battery temperature is measured by the intelligent battery sensor (IBS) attached directly to the battery negative terminal and signalled to the engine management module (DME) via the LIN bus.

The power management uses this value as the input variable for calculating the battery temperature. With the aid of a calculation model, the specified charging voltage is set based on the battery temperature. This information is sent to the alternator via the bit-temperature of serial data interface (BSD).

Battery Regeneration

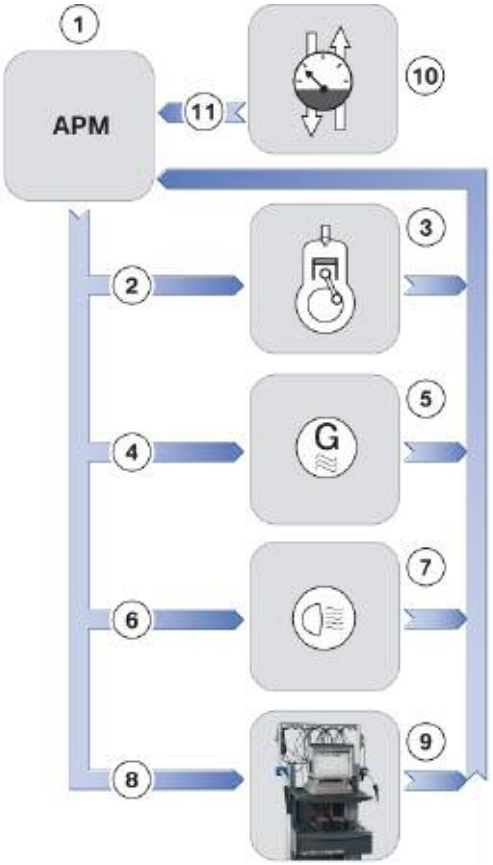
In order to ensure the availability of IGR Low, a certain level of unused capacity must always be retained in the battery. That is implemented by means of IGR High and IGR Medium. For the battery, that means that it is never fully charged. If a battery were not fully charged over a long period or were left fully discharged, sulphation could occur. Sulphation causes a battery to prematurely age, thereby reducing the usable proportion of its rated capacity. To prevent that occurring, the required battery charge voltage function performs a battery regeneration cycle in the course of which the battery is fully charged.

On vehicles with IGR function, regular battery regeneration phases are maintained in order to protect the battery against premature aging and loss of capacity due to cyclic discharge and sulphation. That involves the battery being fully charged using the maximum permissible charge voltage taking account of ambient conditions (temperature, charge level).

Emergency Operation

The APM makes use of emergency operation set to a constant 14.3 V. A fault code functions when there is a break in the LIN "Communication LIN" is entered in the fault interface. In this case, the alternator voltage is code memory of the engine management.

APM Control System



Index	Explanation
1	Advanced power management
2	Idle speed boost
3	Combustion engine
4	Charging voltage target value
5	Alternator
6	Electric load reduction
7	Electric loads
8	Electrical system and battery diagnosis
9	BMW diagnostic system
10	Intelligent battery sensor
11	Battery data

Electric Load Reduction

In order to reduce the power consumption in critical situations, not only can the idling speed be increased and the required charge voltage raised, the power of various non-essential electrical devices can be reduced or they can be switched off altogether. That prevents the battery being discharged.

The electrical devices (that consume power when the engine is running) are subdivided into two classes.

- **Class A**
  A reduction of the power consumption or shut-down of these devices is only noticeable to the driver to a limited degree or after a delay. Individual Class A devices are only switched off or have their power consumption reduced under the following 2 conditions:
  - Battery charge status in critical range
  - High load on alternator.
- **Class B**
  A reduction of the power consumption or shut-down of these functions is immediately noticeable to the driver. Individual Class B devices are only switched off or have their power consumption reduced under the following condition:
  - Battery charge status in critical range.

Class A Electrical Devices

The following measures are taken for Class A devices under the conditions specified above:

Sequence	Function	Operation	Control unit
1	Rear window defogger	Clocking	IHKA
2	Seat heating, rear Electric auxiliary heater, rear	Stage 2 75%	SM FAH SM BFH JB FKA
3	Seat heating, front Seat heating, rear	Stage 2 50%	SM FA SM BF JB SM FAH SM BFH JB
4	Electric auxiliary heater, rear	50%	FKA
5	Seat heating, front Seat heating, rear	50% Stage 1	SMFA SMBF JB SM FAH SM BFH JB
6	Electric auxiliary heater, rear Steering wheel heating	25% 50%	FKA SZL
7	Electric auxiliary heater, rear Mirror heating Washer-jet heating	OFF OFF OFF	FKA FRM/JB JB
8	Steering wheel heating	OFF	SZL
9	Seat heating, front Seat heating, rear	OFF OFF	SMFA SMBF JB SM FAH SM BFH JB

Sequence	Function	Operation	Control unit
10	Rear window defogger	OFF	IHKA
	Top-HiFi system or BMW individual high end audio system	Maximum 30 A power consumption after engine started	Top HiFi High End Audio

All measures are implemented in the specified order.

Class B Electrical Devices

The following measures are taken for Class B devices under the conditions specified above:

Sequence	Function	Operation	Control unit
1	Top-HiFi system or BMW individual high end audio system Heater fan, front and rear	Maximum 30 A power consumption in general 75%	Top HiFi High End Audio IHKA FKA HKA
2	Heater fan, front and rear	50	IHKA FKA HKA
3	Heater fan, front and rear	25%	IHKA FKA HKA

All measures are implemented in the specified order.

Once the battery charge level is outside the critical range, the functions are fully available again.

Note: While shut-down of individual devices or reduction of their power consumption is active, the displays remain active (LEDs remain on).

Note: If devices have their power consumption reduced or are switched off, a fault memory entry is registered and the history memory records the duration, odometer reading, and the function concerned.

NOTES PAGE

Advanced Power Management

Vehicle in Stationary Mode

Electric loads in stationary mode

Certain electric loads may be active even when the closed-circuit current monitoring facility of the power management is already in operation. This is necessary for various reasons:

- Legally required electric loads, e.g. side lights, hazard warning system
- Convenience for the customer, e.g. radio function, telephone.

These electric loads must be excluded from the closed-circuit current monitoring system in order to avoid misinterpretation in the power management. For this purpose, these electric loads must log in with the power management.

In turn, the power management recognizes the activity and accepts the higher power consumption when the systems are deactivated, the corresponding control units log off from the power management.

Stationary load log-off

The power management in the engine control can send a request to switch off the active electric loads in stationary mode depending on the battery charge status and the start capability limit. The electrical devices operating when the vehicle is in stationary mode must then deactivate their functions irrespective of the terminal status and must have attained their closed-circuit current within 5 minutes. Legally required electric loads are excluded from this function.

Terminals

New Terminal Designation

The F01/F02 introduces new designations for some of the terminals. A distinction is also made between logical terminals and power supply terminals. The logical terminals are:

- Terminal R
- Terminal 15
- Terminal 50.

The logical terminals do not serve as power supply terminals; instead, they represent a status. They are activated/deactivated by pressing the START-STOP button. Their status is signalled to the control units by means of a bus message.

The power supply terminals are:

- Terminal 30
- Terminal 15N
- Terminal 30B
- Terminal 30F.

The table below details the previous and new terminal designations.

Previous	New
Terminal 15	Terminal 15N
Terminal 30g	Terminal 30B
Terminal 30g_f	Terminal 30F

Terminal	Description
Terminal 15	Terminal 15N
Terminal R	Radio setting
Terminal 30	Continuous positive
Terminal 30g	Continuous positive, time dependent
Terminal 30g_f	Continuous positive, fault dependent

Terminal 15N

Terminal 15N is used to supply power to control units and components that are only intended to be active when the vehicle is being driven, e.g. PDC.

The letter “N” stands for “Nachlauf”, meaning “overrun”. The power supply Terminal 15N is switched on and off by means of the logical Terminal 15. The overrun time after Terminal 15N is switched off is 5 seconds. That time is required so that the control units have enough time to save their data. While Terminal 15N is active, Terminal 30B and Terminal 30F are also active.

Terminal 30B

Terminal 30B supplies power to control units and electrical components that are required when the driver is present.

The letter B stands for “Basic mode”.

Terminal 30B is activated by:

- Pressing the buttons on the radio remote control
- Unlocking/locking/double-locking the vehicle
- Pressing the START-STOP button
- Change of door switch status, change of trunk switch status, change of side-window position
- Bus message.

Regular deactivation by:

- Vehicle double-locked and tailgate closed (one minute overrun)
- Vehicle not double-locked or tailgate open (30 minutes overrun).

Other possible deactivation triggers:

- Upper starting capacity limit reached (one minute overrun)
- “Powerdown”: diagnosis command for purposes of measuring closed-circuit (10 seconds overrun)
- Transport mode (one minute overrun).

While Terminal 30B is active, Terminal 30F is also active.

Terminal 30F

Terminal 30F supplies power to control units and electrical devices that are also required when the driver is not present but which can be switched off in the event of a fault.

Use: all control units that are not supplied by Terminal 15N or Terminal 30B, are not responsible for vehicle access and do not have to meet a legal requirement for permanent operation.

The letter “F” stands for “Fault”.

Terminal 30F is activated by:

- Pressing the buttons on the radio remote control
- Unlocking/locking/double-locking the vehicle
- Pressing the START-STOP button
- Change of door switch status, change of tailgate switch status, change of side-window position
- Bus message.

In the event of a fault (closed-circuit current too high, bus wake-up, sleep-mode inhibitor, start capacity limit reached) Terminal 30F is reset for 10 seconds.

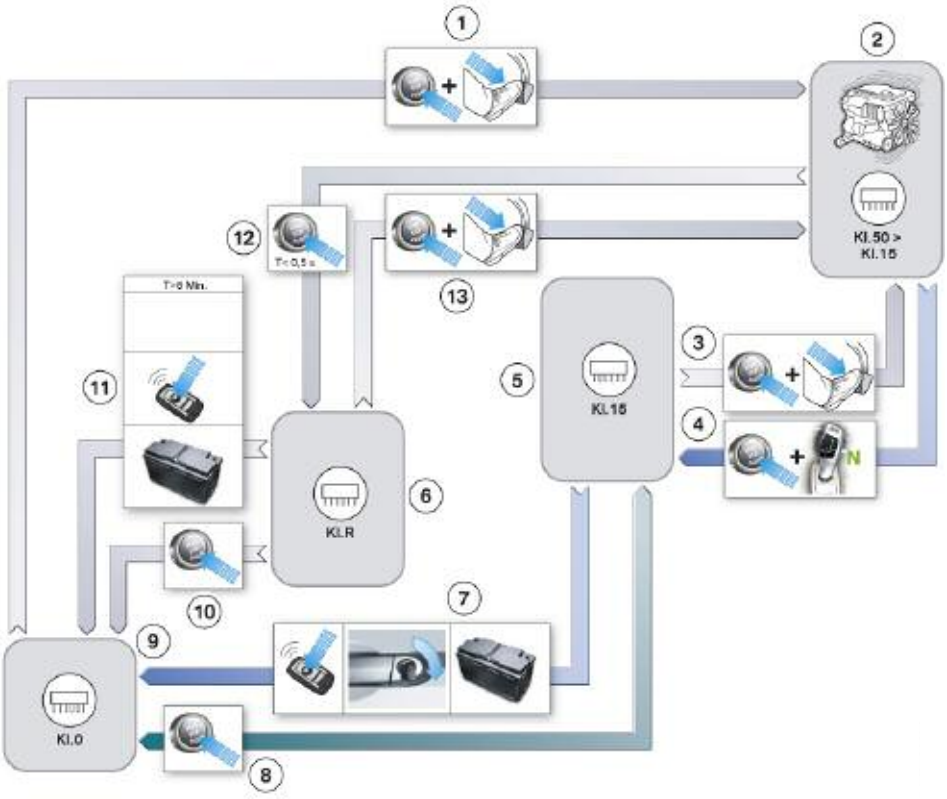
Terminal 30F is not reset or switched off if at least one of the following conditions is met:

- Terminal 30B active
- Parking lights switched on
- Side lights switched on
- Hazard warning lights switched on
- If an extended overrun time for Terminals 30B and 30F is demanded by a service message from any of a number of control units. Example: when the engine is warm, it can be necessary for the electric fan to run on for up to 11 minutes after the vehicle is parked and locked. In order for the electric fan to be operated, the engine management module must be supplied with power. Since the overrun time in that case is only three minutes (that is currently the short overrun time for Terminal 30B, not one minute), the DME requests the appropriate extension by way of a bus message when the engine is switched off.
- “Sticking relay” detected.

Terminal 30F is switched off if Terminal 30B is off and at least one of the following conditions is met:

- Starting capacity limit reached
- Another 10 bus wake-ups have occurred after Terminal 30F reset
- Unexplained bus activity after Terminal 30F reset
- Violation of closed-circuit current limit detected after Terminal 30F reset.

Terminal control



Index	Explanation	Index	Explanation
1	START-STOP button pressed and brake pedal operated --> Terminal 50 is activated and engine starts	8	Pressing the START-STOP button toggles terminal status between Terminal 15 and Terminal 0.
2	Engine running (Terminal 50 > Terminal 15)	9	Terminal 0
3	START-STOP button pressed and brake pedal operated —> Engine starts.	10	Pressing the START-STOP button changes the terminal status from Terminal R to Terminal 0.
4	If selector lever is in position “N” and the engine is stopped by pressing the START-STOP button, Terminal 15 remains on for 15 minutes.	11	Change from Terminal R to Terminal 0 if more than 8 minutes elapsed or vehicle is locked or starting capacity limit reached.
5	Terminal 15	12	START-STOP button briefly pressed -> Engine stops. Terminal R.
6	Terminal R	13	START-STOP button pressed and brake pedal operated —> Engine starts.
7	Terminal 15 OFF when vehicle is locked or starting capacity limit reached.		

Terminal Relays

The F01/F02 has various relays for switching off the power supply to most control units.

Location	Relay	Connection	Controlled by:
Front fuse box	KL 15N	Soldered	CAS
Front fuse box	KL 30B	Plugged in	CAS
Front fuse box	KL30F (bistable)	Soldered	ZGM/DME
Rear fuse box	KL 15N	Soldered	CAS
Rear fuse box	KL 30B	Plugged in	CAS
Rear fuse box	KL30F (bistable)	Soldered	ZGM/DME

The Junction box module controls the bistable relays for Terminal 30F but receives the request from the central gateway module (ZGM) or IBS.

- ZGM: If sleep mode inhibited or on occurrence of unauthorized wake-up.
  ZGM monitors the vehicle status and registers inhibited sleep mode or unauthorized wake-up after Terminal 30B is switched off.
- IBS: If closed-circuit current limit violated or starting capacity limit reached.

The computation for activating the Terminal 30F relay takes place on two control units. The ZGM monitors the following activities:

- Invalid wake-up procedures within the bus systems
- Sleep blockers (control units that constantly keep the bus systems active).

The ECM (DME) continuously reads and assesses the battery data. The relay is also switched off when the starting capability limit of the vehicle battery is reached.

The Terminal 30F relay is a bistable relay and is always in the ON state under normal conditions. It switches off the connected electric loads only in the case of fault. Once the Terminal 30F relay has been switched off, one of the switch-on conditions must be met before it can be switched on again.

Note: More information on this topic can be found in the Reference Information on the CAS.

General Measures

The terminals "load shut-down" and the terminal "interior lighting" are switched off as a general measure when the vehicle is in stationary mode. This occurs only when the vehicle is not locked and secured. These loads are shut down immediately when the vehicle is locked and secured. This measure affects the following electric loads:

Electric loads	Terminal
Interior lighting (front and rear	Load shut-down after 8 minutes (immediately if double locked)
Footwell lighting (front and rear)	Load shut-down after 8 minutes (immediately if double locked)
Reading light (front and rear)	Load shut-down after 8 minutes (immediately if double locked)
Vanity mirror light	Load shut-down after 8 minutes (immediately if double locked)

System Components

Components

The components of the energy management system are:

- Engine
- Alternator
- Vehicle battery
- Intelligent battery sensor
- Junction box module
- Engine management (power management)
- Loads.

The most important components of the energy management system are described in the following.

Intelligent Battery Sensor (IBS)

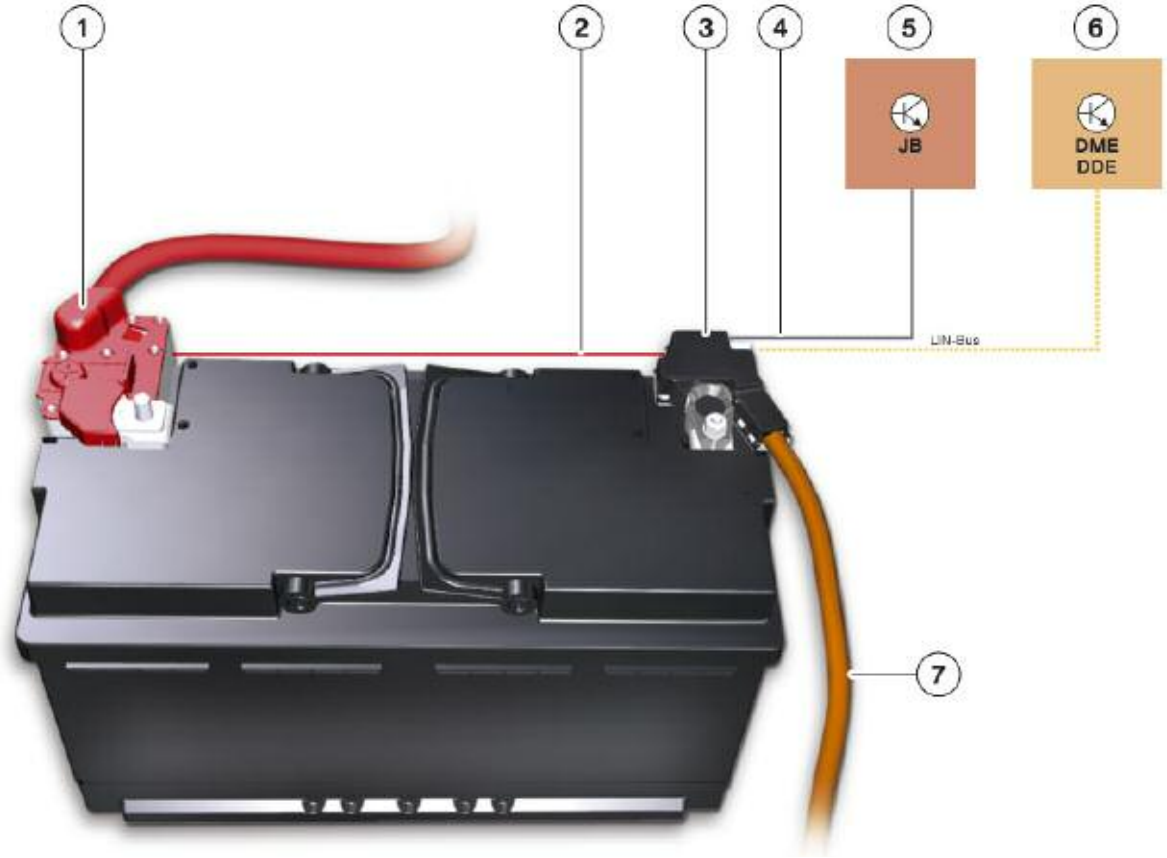
The intelligent battery sensor has a similar range of functions to the intelligent battery sensor on previous models. A new feature is data transmission between the IBS and the engine management module via LIN bus and the wake-up function of the IBS.

Index	Explanation
1	Battery negative terminal
2	IBS
3	Battery negative lead

The intelligent battery sensor (IBS) is a mechatronic component for monitoring the battery condition. The description “intelligent” indicates that the IBS has an integral microprocessor. That microprocessor performs the computation and assessment of time-critical measured variables.

The power supply for the IBS is provided by a separate lead from the power distribution box on the battery. The data from the IBS is passed to the higher-level control units (DME) via the LIN bus. If necessary, the IBS can wake up the Junction box module via a separate lead.

IBS in vehicle network



Index	Explanation	Index	Explanation
1	Battery positive lead	5	Junction box module
2	Power supply for IBS	6	ECM (DME)
3	IBS	7	Battery negative lead
4	Wake-up line	LIN	Local Interconnect Network bus

The following physical battery variables are registered by the IBS:

- Current
- Voltage
- Terminal temperature.

Among other things, the following main functions are integrated in the IBS:

- Continuous measurement of the battery current, voltage and temperature under all vehicle operating conditions.
- Calculation of the battery indicators as the basis for the charge and health status of the battery. The battery indicators are charge and discharge current, voltage and temperature of the vehicle battery. Alongside calculation of the battery indicators, preliminary computation of the battery charge level ("state of charge", SOC) is also carried out.
- Balancing of the charge/discharge current of the battery.
- Continuous monitoring of the battery charge status and making available the corresponding data in the event of insufficient battery power.
- Calculation of the current progression when starting the engine to determine the battery health status.
- Closed-circuit current monitoring of the vehicle.
- Self-diagnosis

Wake-up Function
When the vehicle is in idle mode, the IBS continuously records the data relevant to the battery indicators. The IBS is programmed to wake up every 14 seconds in order to update the measured data by taking new readings. The time required to take the readings is approximately 50 milliseconds. The measured data is stored on the IBS in the memory for recording the closed-circuit current.

The wake-up function applies only when the vehicle is in idle mode. If the IBS detects a wake-up trigger, the Junction box module is woken up by a PWM signal. The IBS is directly connected to the Junction box module via a separate lead.

The pulse duty factor indicates the reason for the wake-up:

Pulse duty factor	Reason for wake-up
20%	Starting capacity, limit 1
40%	Starting capacity, limit 2
60%	Raised closed-circuit current

A wake-up due to raised closed-circuit current can take place up to three times.

Depending on the vehicle status and reason for the wake-up, the Junction box module performs one of the following actions:

- Wakes up the vehicle so that the DME can send shut-down commands to electrical devices that are operating while the vehicle is in parked mode
- Resets Terminal 30F (without waking up the vehicle)
- Switches off Terminal 30F (without waking up the vehicle).

A fault memory entry is registered in each case.

Commissioning
The IBS is fully functional as soon as it has been fitted to the battery terminal (screwed to the grounding point and connected to the signal leads), i.e. it can immediately detect the basic variables, current, voltage and temperature.

However, the variables derived from those readings for the purposes of power management, i.e. battery condition, starting capacity, etc., must first be recalculated and, therefore, there is a time lag before they are available.

When the engine is restarted, the DME reads off the closed-circuit current progression. If it diverges from the defined closed-circuit current progression, a fault is registered in the DME fault memory.

In the period between “Engine OFF” and when the DME main relay is switched off, the IBS is informed by the DME as to the maximum charge that can be drawn from the battery on the basis of ensuring that the engine can be reliably restarted. After the DME main relay is switched off, the IBS continually checks the battery charge level (SOC) and the closed-circuit current.

Junction Box Module

The Junction box module (JBE) is responsible for switching the Terminal 30F relay and for storing information (history data and fault memory entries) related to energy management. As part of vehicle diagnostics, these data can be used to evaluate faults and to analyse the vehicle battery.

Engine Management (Power Management)

The (power management) software for controlling the energy balance is located in the engine management. On the basis of that control algorithm, various electrical devices in the vehicle's electrical system are switched off by the CAS control unit via the Terminal 30B relay or by the Central Gateway Module and engine management module via the Terminal 30F relay. The power management is additionally responsible for evaluating and storing the IBS data.

Service Information

Transport Mode

Indication of Battery Condition

The batteries in vehicles coming off the production line are adequately charged so that SOC > 80% (SOC = "State of charge"). However, since several days or weeks can pass between the time the vehicle comes off the production line and when it is delivered to the customer, the battery will have discharged to a greater or lesser degree. Therefore, every battery must be charged according to the recharging calendar.

The F01/F02 is the first model on which it is possible to display the charge level of the battery when the new car is being transported. When production or transport mode is activated, a Check Control message is generated that provides a quick indication of the battery condition.

Battery condition	Display on instrument cluster	Audible signal	Action
Battery condition OK SOC 60% to 100%		No sound	No action necessary.
Battery is discharged. SOC 35% to 60%		No sound	Charge battery.
Battery charge level is very low. SOC less than 35%		Double gong	Replace battery.

Note: If the SOC has dropped to less than 35%, the indication continues to be displayed on the instrument cluster until the battery is replaced and a change of battery is registered.

Note: When transport mode is reset, there is no indication on the instrument cluster of the battery charge level.

Note: If the vehicle is delivered with the red Check Control message "Battery charge level very low" active, it is essential that the low battery charge is recorded as transport damage on the delivery note.

In such cases, the test module “Energy diagnosis” must be carried out to establish the cause. Replace the battery before handing over the vehicle to the customer and register the change of battery using the service function.

Note: If a vehicle is delivered with the yellow Check Control message “Charge battery”, this should also be recorded on the delivery note. The battery must then be charged once and an energy diagnosis carried out.

Functions switched off/modified in transport mode

On the F01/F02, the following functions are switched off/on in transport mode:

○ = Function is switched off

● = Function is switched on or changed.

Index	Function	Control unit	Transport mode
1	Mirror heating High (driver's/front passenger's door)	FRM	○
2	Home lighting	FRM	○
3	Welcome light	FRM	○
4	Daytime lights (bar can no longer be activated once vehicle has travelled more than 60 km)	FRM	○
5	Side lights in switch position “A” + “2” (at Terminal 15 OFF)	FRM	○
6	Parking light (at Terminal 0)	FRM	○
7	Turning lights	FRM	○
8	Adaptive headlights	FRM	○
9	Main beam assistant	FRM	○
10	Limitation of load shut-down time from 8 minutes to 1 minute (vanity mirrors, reading lights, interior lights are also switched off)	FRM	●
11	Pre-sleep mode, i.e. raised closed-circuit current when vehichle not locked for cyclic scanning of steering column and light selector switch; deactivated 1 minute after Terminal R OFF.	FRM	●
12	Power window (rear driver’s side)	JB	○
13	Power window (rear passenger’s side)	JB	○
14	Headlight washer system (SRA)	JB	○
15	Seat heating Low (driver/passenger, front and rear)	JB	○
16	Washer-jet heating	JB	○
17	Mirror heating Low (driver/passenger)	JB	○
18	Terminal 30F isolation after programmable period: Isolation generally occurs 1 minute after Terminal 30B OFF regardless of lock status.	JB	●
19	Electric sunblinds (middle, left/right)	JB	○
20	Output of Check Control message “TRAMODE” when transport mode set.	JB	●
21	Radio remote control (open/double-lock vehicle) Radio remote control only usable in transport mode when CAS active. To wake vehicle from sleep mode to use radio remote control, tailgate button must be pressed -> Bus awake -> Radio remote control active.	CAS	○

Index	Function	Control unit	Transport mode
22	Radio remote control, open tailgate Reason: transport damage to tailgate on train or truck due to inadvertent opening of tailgate by pressing radio remote control.	CAS	○
23	Limitation of Terminal 30B time from 30 min/60 min to 5 min	CAS	●
24	Reduction of Terminal R active time from 8 minutes to 1 minute regardless of whether door switch operated	CAS	●
25	Immediate switch from Engine Off to Terminal 0when Start/Stop button held pressed and when quickly pressed and released	CAS	●
26	Comfort Access, complete function	CAS	○
27	Slide/tilt sunroof FZD 8 28 DWA function	FZD	○
29	Read outside temperature sensor or cyclic query in vehicle idle mode	Kombi	○
30	Coolant temperature request from DME	Kombi	○
31	Clock function for aux. heating and aux. ventilation functions	Kombi	○
32	Set fault memory bar (excluding transport mode fault memory and high/low voltage fault memory	Kombi	●
33	Tailgate lift	HKL	○
34	Steering wheel heating	SZL	○
35	Seat heating (driver/passenger) SM 8		
36	Seat adjustment, passenger	ISM	○
37	Seat adjustment, rear	ISM	○
38	Lumbar support	ISM	○
39	Active seat ventilation	ISM	○
40	Active seat	ISM	○
41	Rear window defogger	IHKA	○
42	Blower; limitation to max. 50% Caution: if DEFROST button pressed > no limitation i.e. 100% blower output possible.	IHKA	●
43	Defrost function (100% fan power possible)	IHKA	●
44	Compressor coupling closed so disconnected from power	IHKA	○
45	Electric auxiliary heater (PTC)	IHKA	○
46	Residual heat function	IHKA	○
47	Auxiliary ventilation function	IHKA	○
48	Independent ventilation function	IHKA	○
49	PATT module	IHKA	○
50	Run-on of interior temp. sensor fan from Terminal R Off	IHKA	○

Index	Function	Control unit	Transport mode
51	Air vent positioning immediately after Terminal R OFF (due to Term. 30B + Term. 30F switching off)	IHKA	●
52	Aux. coolant pump and valve	IHKA	○
53	Rear fan; (total shut-down)	FKA	○
54	Rear PTC, left/right	FKA	○
55	Rear A/C control panel	FKA	○
56	Rear A/C fan; (total shut-down)	HKA	○
57	Flap setting	HKA	○
58	Head unit MOST active, unusable, no display, no entertainment system output; nevertheless, sound output from PDC; \ Diagnosis of MOST control units possible; MOST devices "not functioning": Top HiFi, CDC, DVD changer, ULF-SBX, SDARS/IBOC, RSE	CIC	●
59	HiFi amplifier, audio output	Top HiFi	○
60	Central information display, front	CID	○
61	Central information display, rear	FD	○
62	Video switch, video output and reception	VSW	○
63	Controller, rear Controller	CON/FCON	○
64	Bluetooth interface	ULF-SBX	○
65	Telematics function	TCU	○
66	Emergency call function	TCU	○
67	Telephone control, prevent wake-up of MOST bus	TCU	○
68	Night Vision	NVE	○
69	HUD (Head-up display)	HUD	○
70	All cameras	KAFAS	○
71	Ride height monitoring and levelling during overrun	EHC	○
72	Power supply to wheel satellites for VDC	VDM	○
73	ARS valves (5 in total)	VDM	○
74	ACC (heater, camera)	ICM	○
75	Power supply for RDC transmitter/function	RDC	○
76	Speed limitation to 4500 rpm	DME	●
77	Idle speed boost (upper idle speed value)	DME	●
78	Maximum charging voltage (+14.8 V to 40 °C)	DME	●
79	Deactivating IGR function	DME	○
80	Battery charge indication by CCM	DME	●

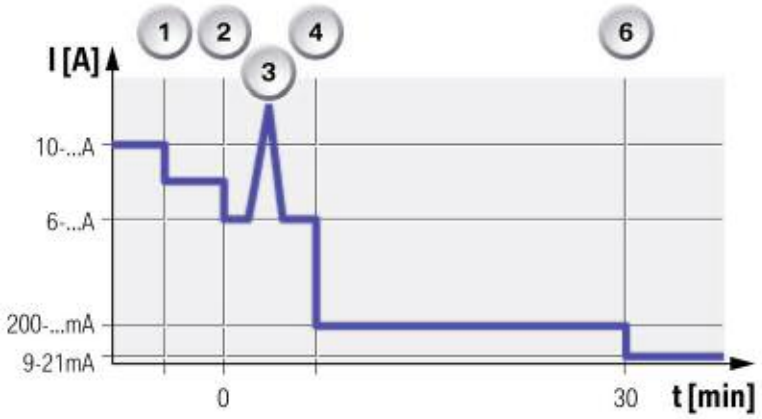
Closed-circuit Current

Upwards of a closed-circuit current level of 80 mA, a Check Control message is generated (raised battery discharge rate when parked).

Note: The closed-circuit current should always be measured if increased current consumption is suspected. Even power consumption levels only slightly above normal can cause relatively rapid battery discharge.

The graph below shows the typical closed-circuit current progression on the F01/F02 associated with the various electrical system statuses. The actual current values change depending on the vehicle equipment configuration.

Typical closed-circuit current progression for double-locked vehicle on F01/F02

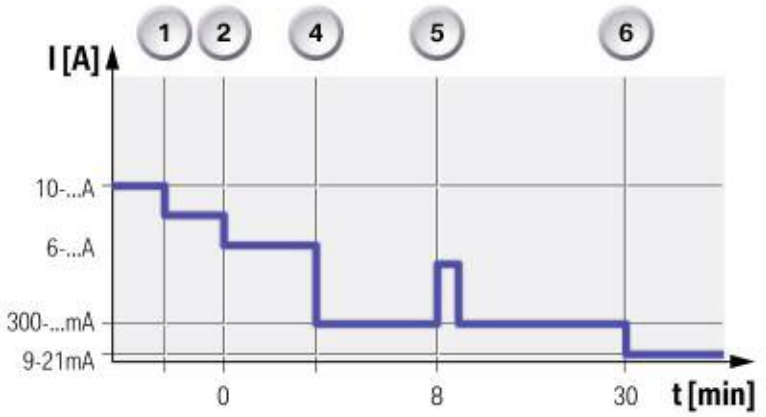


The terminal “load shut-down” (e.g. reading or 60 minutes with) light and vanity mirror light) is switched off corresponding to the terminal status.

Index	Explanation
1	Terminal 15N off
2	Terminal R off
3	Vehicle is secured (locked)
4	Start of bus rest phase
5	Electrical load shutdown after 8 minutes
6	KL30 B OFF (30 minutes w/o phone or 60 min with)

Load shut-down switches off immediately when the vehicle is secured. In all other terminal statuses, the load shut-down terminal is switched off after an overrun period of 8 minutes. It is activated by the footwell module.

Typical closed-circuit current progression for unlocked vehicle on F01/ F02



Electrical System and Battery Diagnosis

Over the past few years, the energy management of all BMW models has been continuously improved and standardized across the various model series. In terms of energy diagnosis, this also means standardization of testing schedules and displays in the BMW diagnostic system.

The aim of the diagnostic procedures is to show the causes of a discharged battery as unambiguously as possible. In view of the complexity, especially in the area of energy management, the specific cause of a fault can be shown only partially depending on its nature. The acquired energy diagnosis data are shown if the fault cannot be clearly assigned based on the acquired data.

Power management is retained in full while the expanded diagnostic options are now resident in the history memory.

ZGM monitors the vehicle status, registers inhibited sleep mode or unauthorized wake-up after Terminal 30B is switched off and requests a reset or shut-down of Terminal 30F by a bus message to the JBE.

The originator and reason for wake-up (unauthorized wake-up) are stored as additional information in the ZGM fault memory. The driving profile for the last 5 weeks is stored in the JBE energy history memory. The energy history memory is referred to for energy diagnosis purposes.